Congressional Budget Office
Nonpartisan Analysis for the U.S. Congress

Estimating the Economic Effects of Federal Investment in Research and Development

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This presentation is based on a forthcoming working paper that CBO expects to publish in summer 2026.

For information about the conference, see https://tinyurl.com/3h947tar.

How Do Changes in Federal Investment in Research and Development Affect the Economy?

In recent years, Congress has shown interest in making policy changes that affect research and development (R&D), such as:

- Modifications to federal funding for R&D investment (for example, the CHIPS and Science Act, Public Law 117-167) and
- Modifications to tax provisions that affect the after-tax price of private R&D (for example, the 2025 reconciliation act, P.L. 119-21).

This presentation details CBO's current basis of assessment for modeling the economic effects of changes in federal funding for nondefense R&D, with the goal of eliciting feedback.

As in our preliminary analysis published last July (CBO 2025), we consider policy experiments that either increase or decrease federal funding for nondefense R&D by $30 billion per year for 10 years, from 2027 to 2036.

Road Map: Two Analytical Frameworks

R&D Capital Stock Approach

- Directly connects changes in federal funding for R&D with changes in the R&D capital stock, which generate changes in TFP and GDP
- Directly connects with the standard way R&D appears in BEA's NIPA data
- Builds on CBO's prior work estimating the economic effects of changes in federal investment in physical infrastructure such as highways (CBO 2021)

Human Capital Approach

- Allocates federal funding for R&D across labor and capital, consistent with historical spending patterns in which funding for labor supports both the work of additional researchers and the training of new researchers
- Builds on CBO's prior work estimating the economic effects of changes in the number of other foreign nationals who work in STEM fields (CBO 2024) and of changes in the capital stock (Lasky 2018)

The other-foreign-national category includes those who entered the United States illegally and who have not obtained a permanent legal status, those who were permitted to enter the country lawfully through the use of parole authority and who may be awaiting proceedings in immigration court, and those who previously resided in the United States legally in a temporary status but who remained in the country after that legal status expired.

BEA = Bureau of Economic Analysis; NIPA = national income and product accounts; STEM = science, technology, engineering, and mathematics; TFP = total factor productivity.

Background

Federal Outlays for R&D

Billions of dollars

	Agency	Outlays
Nondefense R&D	Department of Health and Human Services	51.0
	National Aeronautics and Space Administration	11.3
	Department of Energy	9.2
	National Science Foundation	6.8
	Department of Agriculture	3.1
	Department of Commerce	2.3
	Department of Veterans Affairs	1.8
	Department of Transportation	0.9
	Department of Homeland Security	0.6
	Environmental Protection Agency	0.6
	Other nondefense agencies	2.3
	Subtotal, nondefense R&D	89.6
Defense R&D	Department of Defense	75.6
	Department of Energy	3.9
	Subtotal, defense R&D	79.5
	Total outlays for R&D	**169.1**

Data source: National Center for Science and Engineering Statistics (2025), Table 4.

This table shows data for fiscal year 2023, the most recent year for which such data are available.

Recipients of Federal Funding for R&D

Recipient	Percentage of total federal obligations for nondefense R&D, 2010–2023
Higher education institutions	37
Federal agencies	27
Businesses	15
Federally funded research and development centers	11
Nonprofit organizations	9
State governments	1

Data source: Congressional Budget Office, using data from the National Center for Science and Engineering Statistics (2010–2023).

Each recipient's share was calculated by dividing the cumulative federal obligations for nondefense R&D made to the recipient over the 2010–2023 period by the total federal obligations for nondefense R&D over that period. An obligation is a legally binding commitment by the federal government that will result in outlays, immediately or in the future.

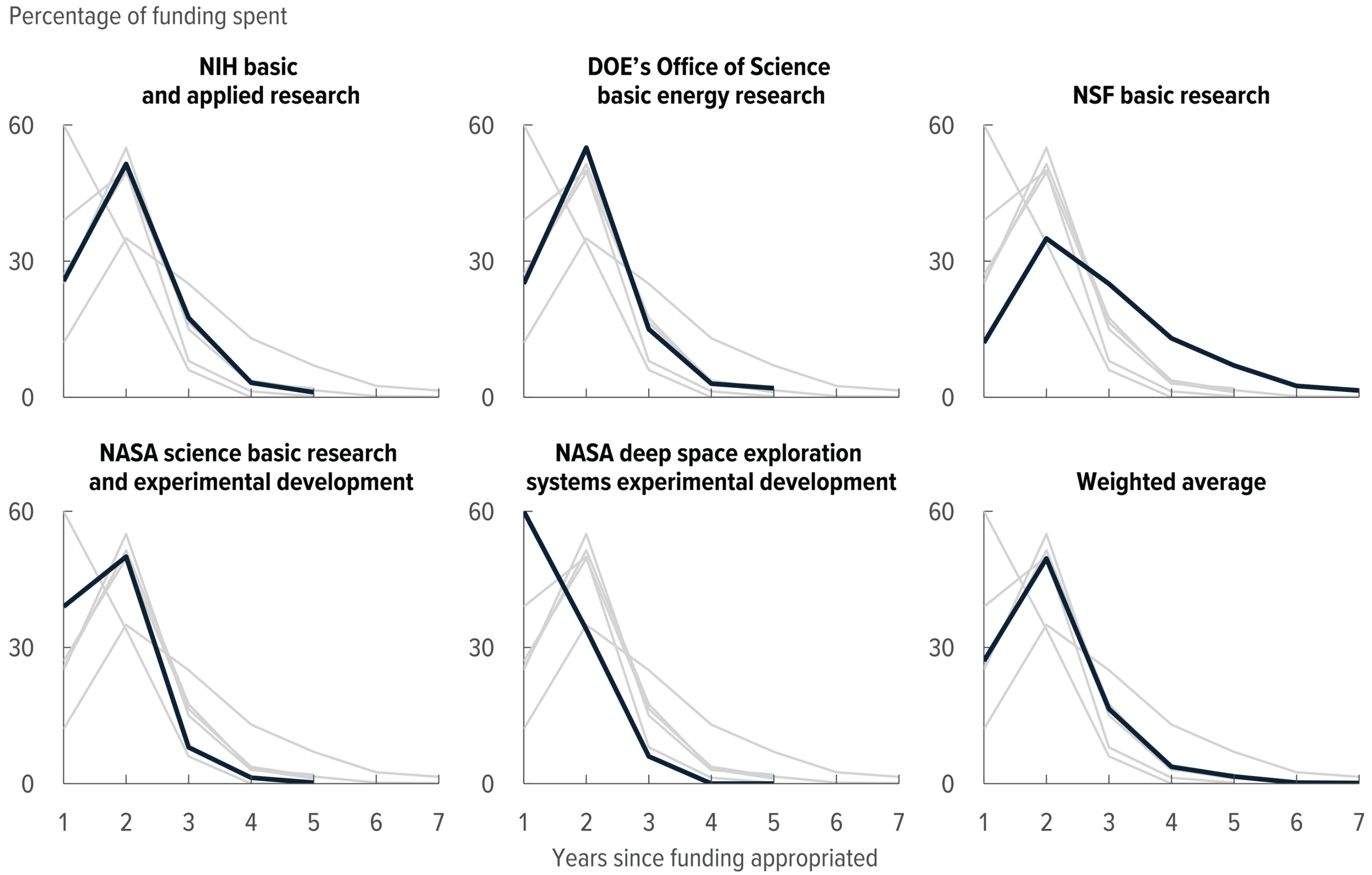
Federally funded research and development centers are exclusively or substantially funded by the federal government and are administered by firms, universities, or other nonprofit organizations.

R&D Capital Stock Framework

Key Factors

- Time between funding and outlays
- Changes in nonfederal R&D activity
- Time between outlays and productivity effects
- Magnitude of productivity effects
- Depreciation of R&D capital

Time Between Funding and Outlays

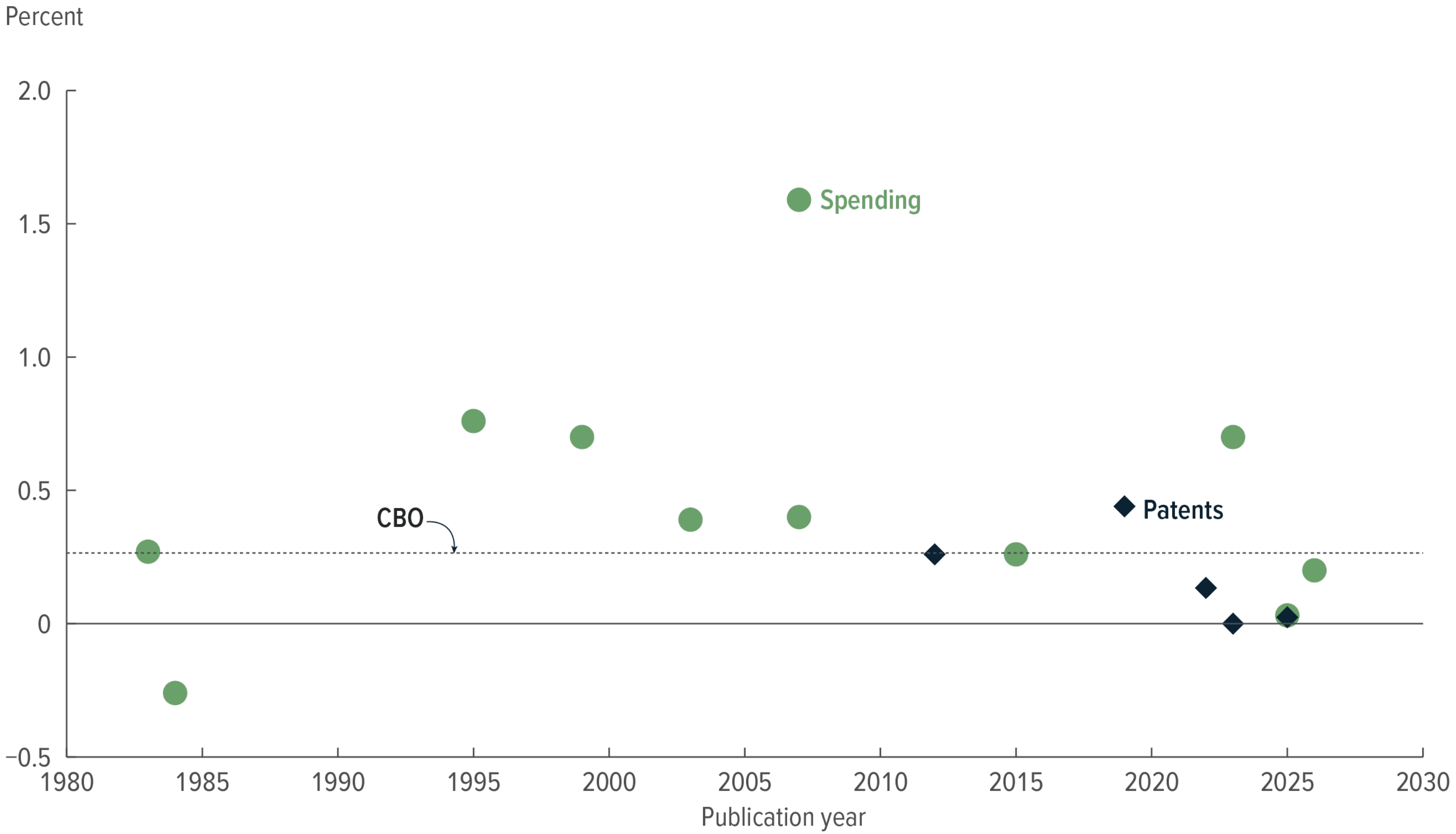


Data source: Congressional Budget Office.

To estimate the timing of cumulative outlays, CBO used account-level rates that are based on historical patterns. Accounts shown here are those whose outlays made up more than 1 percent of the total federal outlays for nondefense R&D over the 2020–2024 period. The combined outlays for those accounts constituted 74 percent of federal outlays for nondefense R&D over that period. To calculate the average rate, CBO weighted each account's spending rate in a given year by the account's share of that 74 percent.

DOE = Department of Energy; NASA = National Aeronautics and Space Administration; NIH = National Institutes of Health; NSF = National Science Foundation.

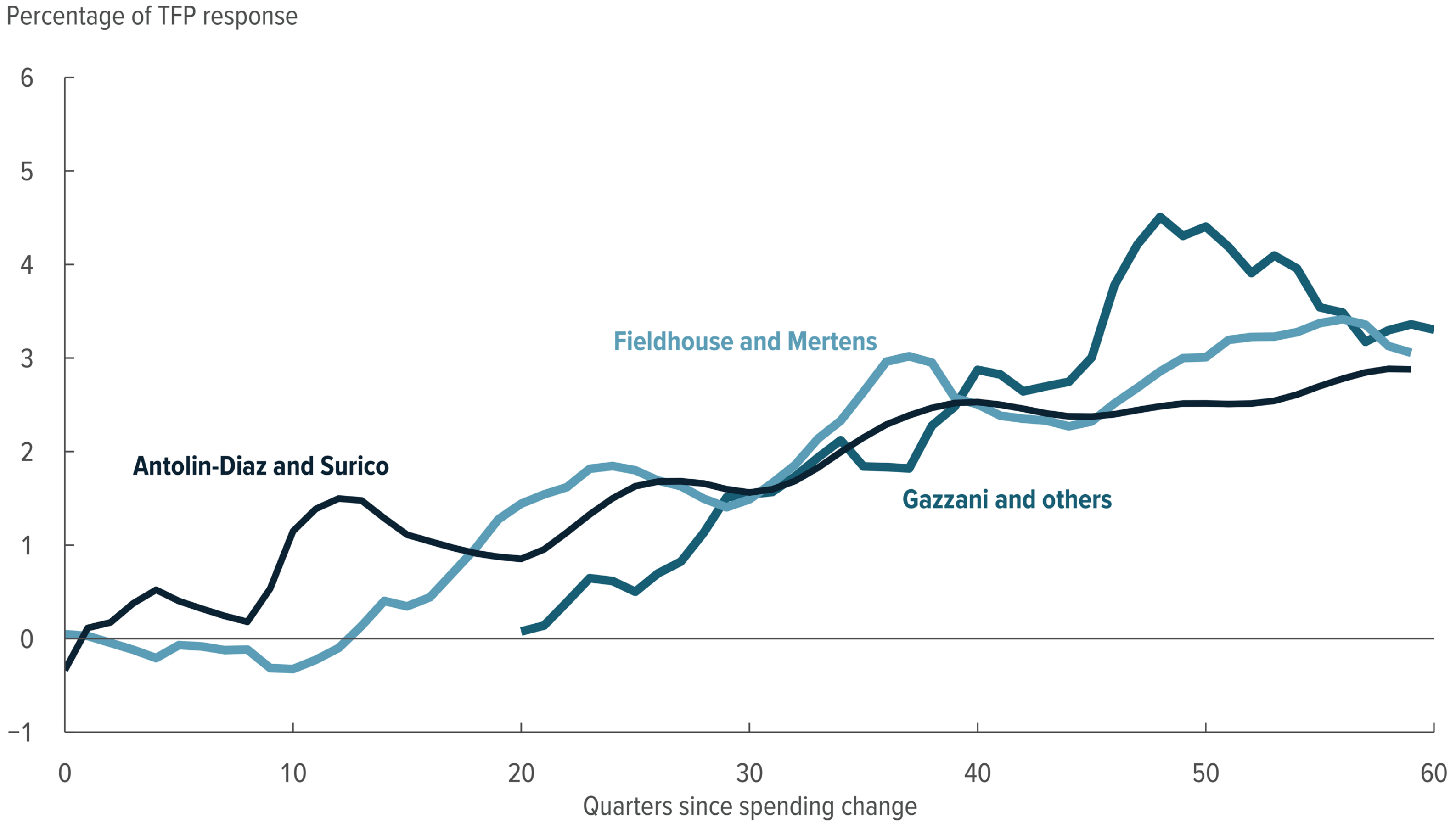
Changes in Nonfederal R&D Activity



Data sources: Congressional Budget Office; Archibald and Pereira (2003); Blume-Kohout (2012, 2023); Blume-Kohout, Kumar, and Sood (2015); Diamond (1999); Dyèvre (2024); Fieldhouse and Mertens (2026); Levy and Terleckyj (1983); Lichtenberg (1984); Myers and Lanahan (2022); Toole (2007); Ward and Dranove (1995).

Each value represents one study's estimate of the change in nonfederal R&D spending or patents that results from a 1 percent increase in federal spending on R&D.

Time Between Outlays and Productivity Effects

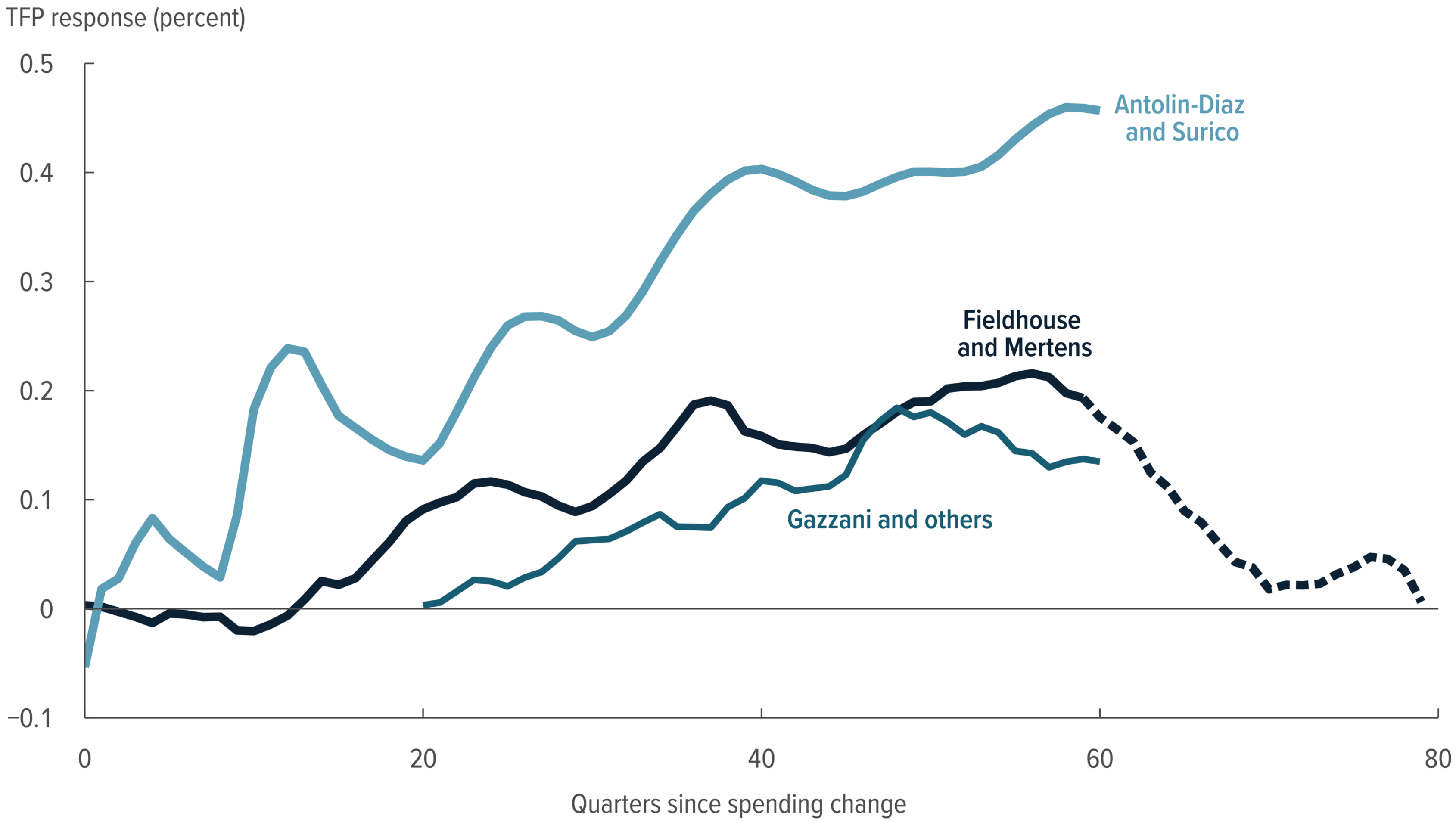


Data source: Congressional Budget Office, using data from the following sources: Antolin-Diaz and Surico (2025), Figure 10 (adjusted TFP panel); Fieldhouse and Mertens (2026), Figure 6 (business-sector TFP panel); Gazzani and others (2025), unpublished results.

For each set of results, CBO summed the observed TFP responses over the period of analysis described in the corresponding paper and then calculated the share of the total response for each quarter. The start of TFP effects in the Gazzani and others series is delayed by five years, reflecting the time between spending and patent applications shown in Li and others (2017), Figure 1.

This slide has been updated since its original publication.

Magnitude of Productivity Effects



Data sources: Congressional Budget Office, using data from Gazzani and others (2025), unpublished results; Antolin-Diaz and Surico (2025), Figure 10 (adjusted TFP panel); Fieldhouse and Mertens (2026), Figure 6 (business-sector TFP panel).

The extension of the Fieldhouse and Mertens line to 20 years is based on unpublished results shared with CBO.

This slide has been updated since its original publication.

Depreciation of R&D Capital

The research literature generally applies BEA's standard R&D depreciation rate of 16 percent.

- Crawford and others (2014) tabulate depreciation rates for categories of R&D: 7 percent for aerospace, 9 percent for health and energy, and 16 percent for other nondefense R&D.
- Weighted by shares of federal spending on R&D, those rates imply a depreciation rate of 9.5 percent.

An important conceptual issue is that those depreciation rates are arguably intended to capture a private depreciation rate relevant to an owner of an R&D asset (Li and Hall 2020).

- The concept of depreciation relevant to CBO's work is the *economywide* depreciation rate.
- An approach based on patent citations implies an economywide depreciation rate of 5 percent, which we use in this analysis.

Human Capital Framework

Human Capital Framework

Federal funding for R&D is allocated to labor or capital.

- We draw on data from the National Science Foundation's National Center for Science and Engineering Statistics and BEA's R&D satellite account.
- On average, 54 percent of federal funding for R&D pays for labor.
- For institutions of higher education, we draw on the analysis of UMETRICS data in Sattari and others (2022) and Ikudo and others (2019) to allocate spending (across, for example, postdocs and undergraduates).
- We account for changes in R&D spending by nonfederal organizations, as in the R&D capital stock approach.

For labor, we estimate effects through two channels:

- **Reallocation.** Federal funding for R&D allows additional people to work as researchers, and that additional work (measured in researcher-years) contributes to TFP.
- **Training.** The roughly 40 percent of federal funding for R&D allocated to institutions of higher education partially supports the training of additional researchers. Because of the time associated with training, those additional researcher-years contribute to TFP with a longer lag but also over a longer period.

For capital, we apply CBO's standard capital investment framework (Lasky 2018).

UMETRICS = Universities Measuring the Effects of Research on Innovation, Competitiveness, and Science.

Reallocation

We start with an estimate of the economywide change in the number of researchers, drawing on Fieldhouse and Mertens (2026), Figure 7(e).

We apply the estimates from Figure 2 in Sattari and others (2022) to allocate that change in the number of researchers across researchers of different education levels, following Ikudo and others (2019).

Finally, we account for education-specific effects on TFP by:

- Estimating average TFP effects per researcher engaged in innovation-related activities on the basis of Prato (2025) and related evidence (CBO 2024);
- Estimating, for different education levels, the share of researchers engaged in innovation-related activities by using patenting rates in Hunt (2011) and then adjusting TFP effects for nonpatenting researchers downward by 50 percent; and
- Estimating relative TFP effects by level of education using wages in Hunt (2011).

Training

We start with an estimate of the economywide change in the number of workers with PhDs in STEM fields, drawing on Fieldhouse and Mertens (2026), Figure 7(d).

We are in the process of estimating the economywide change in the number of workers with master's degrees in STEM fields, following Sattari and others (2022).

We currently lack a basis for estimating a training component for:

- Postdocs relative to PhDs and
- Undergraduate researchers.

Uncertainty

Areas of Uncertainty

R&D capital stock approach

- Estimates of the economywide R&D depreciation rate
- Differences in estimates of productivity effects

Human capital approach

- Estimates of economywide changes in the number of researchers, postdocs, and workers with PhDs
- Training effects for undergraduate student researchers
- Basis for estimating relative productivity effects by education, especially for postdocs
- Appropriate occupational definition of “researcher”

Both approaches

- Treatment of indirect costs
- Economic effects of changes in private investment in R&D
- How changes in federal funding for R&D interact with immigration policy

References (1 of 4)

Juan Antolin-Diaz and Paolo Surico (2025), "The Long-Run Effects of Government Spending," *American Economic Review*, vol. 115, no. 7 (July), pp. 2376–2413, https://doi.org/10.1257/aer.20231278.

Robert B. Archibald and Alfredo M. Pereira (2003), "Effects of Public and Private R&D on Private-Sector Performance in the United States," *Public Finance Review*, vol. 31, no. 4 (July), pp. 429–451, https://doi.org/10.1177/1091142103031004005.

Margaret E. Blume-Kohout (2012), "Does Targeted, Disease-Specific Public Research Funding Influence Pharmaceutical Innovation?" *Journal of Policy Analysis and Management*, vol. 31, no. 3 (Summer), pp. 641–660, https://doi.org/10.1002/pam.21640.

Margaret E. Blume-Kohout (2023), "The Case of the Interrupting Funder: Dynamic Effects of R&D Funding and Patenting in U.S. Universities," *Journal of Technology Transfer*, vol. 48, no. 4 (August), pp. 1221–1242, https://doi.org/10.1007/s10961-022-09965-7.

Margaret E. Blume-Kohout, Krishna B. Kumar, and Neeraj Sood (2015), "University R&D Funding Strategies in a Changing Federal Funding Environment," *Science and Public Policy*, vol. 42, no. 3 (June), pp. 355–368, https://doi.org/10.1093/scipol/scu054.

Congressional Budget Office (2021), *Effects of Physical Infrastructure Spending on the Economy and the Budget Under Two Illustrative Scenarios* (August), www.cbo.gov/publication/57327.

Congressional Budget Office (2024), *Effects of the Immigration Surge on the Federal Budget and the Economy* (July), www.cbo.gov/publication/60165.

References (2 of 4)

Congressional Budget Office (2025), letter to the Honorable Brendan F. Boyle and the Honorable Jake Auchincloss providing a preliminary analysis of how federal investment in nondefense research and development affects the economy and the federal budget (July 30), www.cbo.gov/publication/61375.

Marissa J. Crawford and others (2014), "Measuring R&D in the National Economic Accounting System," *Survey of Current Business* (November), https://tinyurl.com/4rsc2w25.

Arthur M. Diamond Jr. (1999), "Does Federal Funding 'Crowd In' Private Funding of Science?" *Contemporary Economic Policy*, vol. 17, no. 4 (October), pp. 423–431, https://doi.org/10.1111/j.1465-7287.1999.tb00694.x.

Arnaud Dyèvre (2024), *Public R&D Spillovers and Productivity Growth* (London School of Economics, January 22), https://tinyurl.com/nhzy9bsv.

Andrew J. Fieldhouse and Karel Mertens (2026), *The Returns to Government R&D: Evidence From U.S. Appropriations Shocks* (February 21), https://andrewjfieldhouse.com/research.

Andrea Gazzani and others (2025), *The Public Origins of American Innovation*, CEPR Discussion Paper 20788 (Centre for Economic Policy Research, October 26), https://cepr.org/publications/dp20788-1.

Jennifer Hunt (2011), "Which Immigrants Are Most Innovative and Entrepreneurial? Distinctions by Entry Visa," *Journal of Labor Economics*, vol. 29, no. 3 (July), pp. 417–457, https://doi.org/10.1086/659409.

References (3 of 4)

Akina Ikudo and others (2019), "Occupational Classifications: A Machine Learning Approach," *Journal of Economic and Social Measurement*, vol. 44, no. 2–3 (May), pp. 57–87, https://doi.org/10.3233/JEM-190463.

Mark Lasky (2018), *CBO's Model for Forecasting Business Investment*, Working Paper 2018-09 (Congressional Budget Office, December), www.cbo.gov/publication/54871.

David M. Levy and Nestor E. Terleckyj (1983), "Effects of Government R&D on Private R&D Investment and Productivity: A Macroeconomic Analysis," *Bell Journal of Economics*, vol. 14, no. 2 (Autumn), pp. 551–561, https://doi.org/10.2307/3003656.

Danielle Li, Pierre Azoulay, and Bhaven N. Sampat (2017), "The Applied Value of Public Investments in Biomedical Research," *Science*, vol. 356, no. 6333 (April 7), pp. 78–81, https://doi.org/10.1126/science.aal0010.

Wendy C. Y. Li and Bronwyn H. Hall (2020), "Depreciation of Business R&D Capital," *Review of Income and Wealth*, vol. 66, no. 1 (March), pp. 161–180, https://doi.org/10.1111/roiw.12380.

Frank R. Lichtenberg (1984), "The Relationship Between Federal Contract R&D and Company R&D," *American Economic Review*, vol. 74, no. 2 (May), pp. 73–78, https://www.jstor.org/stable/1816333.

Kyle R. Myers and Lauren Lanahan (2022), "Estimating Spillovers From Publicly Funded R&D: Evidence From the U.S. Department of Energy," *American Economic Review*, vol. 112, no. 7 (July), pp. 2393–2423, https://doi.org/10.1257/aer.20210678.

National Center for Science and Engineering Statistics (2010–2023), Survey of Federal Funds for Research and Development, https://tinyurl.com/mrw8x4p5.

References (4 of 4)

National Center for Science and Engineering Statistics (2025), Survey of Federal Funds for Research and Development, NSF 25-328 (March), https://tinyurl.com/29jp6nvh.

Marta Prato (2025), “The Global Race for Talent: Brain Drain, Knowledge Transfer, and Growth,” *Quarterly Journal of Economics*, vol. 140, no. 1 (February), pp. 165–238, https://doi.org/10.1093/qje/qjae040.

Reza Sattari and others (2022), “The Ripple Effects of Funding on Researchers and Output,” *Science Advances*, vol. 8, no. 16 (April 22), https://doi.org/10.1126/sciadv.abb7348.

Andrew A. Toole (2007), “Does Public Scientific Research Complement Private Investment in Research and Development in the Pharmaceutical Industry?” *Journal of Law and Economics*, vol. 50, no. 1 (February), pp. 81–104, https://doi.org/10.1086/508314.

Michael R. Ward and David Dranove (1995), “The Vertical Chain of Research and Development in the Pharmaceutical Industry,” *Economic Inquiry*, vol. 33, no. 1 (January), pp. 70–87, https://doi.org/10.1111/j.1465-7295.1995.tb01847.x.